

BMJ Open Factors associated with health literacy in multimorbid patients in primary care: a cross-sectional study in Switzerland

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ABSTRACT

Objective To identify factors associated with health literacy in multimorbid patients.

Design A nationwide cross-sectional study in Switzerland. Univariate and multivariate linear regressions were calculated to identify variables associated with health literacy. A multiple imputation approach was used to deal with missing values.

Participants Multimorbid patients recruited in primary care settings (n=888), above 18 years old and suffering from at least 3 of 75 chronic conditions on a predefined list based on the International Classification of Primary Care 2.

Main measures Health literacy was assessed using the European Health Literacy Survey project questionnaire (HLS-EU 6). This comprises six items scored from 1 to 4 (very difficult=1, fairly difficult=2, fairly easy=3, very easy=4), and the total health literacy score is computed as their mean. As we wished to understand the determinants associated with lower health literacy, the HLS-EU 6 score was the only dependent variable; all other covariates were considered independent.

Results The mean health literacy score (SD) was 2.9 (0.5). Multivariate analyses found significant associations between low health literacy scores and treatment burden scores ($\beta=-0.004$, 95% CI -0.006 to 0.002); marital status, predominantly the divorced group ($\beta=0.136$, 95% CI 0.012 to 0.260); dimensions of the EuroQol 5 Dimension 3 Level (EQ5D3L) quality of life assessment, that is, for moderate problems with mobility ($\beta=-0.086$, 95% CI -0.157 to 0.016); and with moderate problems ($\beta=-0.129$, 95% CI -0.198 to 0.060) and severe problems with anxiety/depression ($\beta=-0.343$, 95% CI -0.500 to 0.186).

Conclusions Multimorbid patients with a high treatment burden, altered quality of life by problems with mobility, anxiety or depression, often also have low levels of health literacy. Primary care practitioners should therefore pay particular attention to these patients in their daily practice.

INTRODUCTION

Multimorbidity, defined as the occurrence of multiple chronic medical conditions in one individual,¹⁻³ is a steadily increasing phenomenon due to population ageing.^{4 5} Multimorbid patients must face

Strengths and limitations of this study

- This national primary care study enabled the analysis of data from a sample of multimorbid patients.
- The first study to understand factors associated with health literacy in multimorbid patients in primary care settings.
- Only multimorbid patients with at least three chronic conditions were assessed.
- Causal relationships could not be inferred due to the study design.

many challenges: more frequent and longer hospitalisations,^{6 7} greater use of polypharmacy (causing adverse drug effects),^{8 9} higher expenditure on healthcare¹⁰⁻¹² and the use of a broader range of healthcare services.^{8 10} Moreover, as the number of health professionals involved in treatment increases, the more likely patients will be faced with fragmented medical care due to conflicting instructions and care pathways. This makes piecing together and adhering to instructions even more testing and thus prevents patients from participating effectively in their own care.^{8 10 12} Facing all these challenges effectively requires good levels of health literacy (HL). The US Institute of Medicine defines HL as 'the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions'.^{13 14} HL includes a broad set of skills (ie, reading, writing, numeracy, communication and increasingly, the use of digital technologies) needed to make appropriate health decisions and successfully navigate the healthcare system.¹⁵ HL is recognised as an important determinant of health.¹⁶⁻¹⁸ Studies have shown that lower HL is associated with a lower mental and physical health status, adverse disease-specific

outcomes, higher mortality and more use of health-care but less use of preventive care.^{17 19} Consequently, governments, researchers, clinicians and patients' associations are paying ever more attention to research into HL.²⁰

Effective patient–clinician communication that ensures patients are able to understand the health information and treatment recommendations they receive and feel comfortable enough to ask questions or admit when they do not understand something, is vital to the successful management of a chronic illness.²¹ Healthcare providers should be conscious of their patients' HL skills so as to ensure that health information is communicated effectively to help manage long-term conditions.^{22 23} Additionally, HL is a prerequisite for patient activation and shared decision-making.^{24–26} Thus, identifying factors associated with low HL is an important step towards devising effective engagement, prevention and intervention strategies for patients in primary care.²⁰ The literature shows that HL has been assessed in different ways and with contrasting conclusions, for example, different studies looking at the factors influencing HL among less well-educated young people showed a relationship between low HL and socioeconomic factors.^{17 27 28} One study evaluating relevant associations between HL and multimorbidity (defined as two or more chronic diseases from a list of 11 conditions) in primary care, found none.¹⁴ To better understand the determinants associated with low HL, the present study aimed to explore all the factors that might be associated with low HL in multimorbid patients in primary care with at least three chronic conditions.

METHODS

Participants and procedures

We analysed data (n=888) from a national cross-sectional survey conducted in collaboration with Switzerland's five academic institutes of family medicine, between January and September 2015. The study was designed to assess multimorbidity in patients in a primary care setting in order to target a population whose management is more challenging to general practitioners (GPs). The detailed study protocol, dataset description and initial results have been published elsewhere.^{29 30}

A convenience sample of 100 GPs randomly enrolled patients from their practices who consulted them during the study period. Each GP was provided with a randomisation calendar specifying which patients to enrol on each half-day during the recruitment weeks. All multimorbid patients above 18 years old and suffering from at least 3 of 75 chronic conditions on a predefined list, based on the International Classification of Primary Care 2 (ICPC-2), were considered eligible^{31 32} and gave written informed consent to participate in the study. GPs completed a paper-based questionnaire for each included patient (patient-related variables assessed through the GP

survey). Patients enrolled completed a telephone-based questionnaire.

Measures

Health literacy

HL was assessed using the validated six-item questionnaire from the European Health Literacy Survey project (HLS-EU 6).^{33 34} The HLS-EU was a Europe-wide project developed to gather data on HL.³³ The original HLS-EU 47 explored three domains: (1) healthcare; (2) disease prevention and (3) health promotion. Each domain explored four matrices: accessing/obtaining information; understanding information; processing/appraising information and applying/using information. The HLS-EU 6 is a validated short form with two of the original questions remaining in each domain.^{33–35} Validated French and German versions of the HLS-EU 6 were available by the authors.³⁴ We used this shorter, validated questionnaire because the present study's main objective was to measure overall levels of HL in multimorbid patients, not to assess HL in detail. The HLS-EU 6 scale consists of six items with five possible responses. Participants were asked to respond to the following questions. How easy or difficult is it for you to: (1) judge when you may need to get a second opinion from another doctor? (2) use information the doctor gives you to make decisions about your illness? (3) find information on how to manage mental health problems like stress or depression? (4) judge whether the information on health risks in the media is reliable? (5) find out about activities that are good for your mental well-being? and (6) understand information in the media on how to get healthier? The possible responses and their scores were as follows: very difficult=1, fairly difficult=2, fairly easy=3, very easy=4, and a fifth alternative for when participants did not answer or did not have a definite answer, coded as a missing value. The HL score was thus calculated as the mean of the six HL items, scored from 1 to 4, after imputation of the missing values (see Statistical analyses section).³⁴

Covariates

All the variables have been described elsewhere previously.²⁹ Briefly, our analyses used the following variables:

- Dependent variable: as we wished to understand the determinants associated with lower HL scores, we chose the HLS-EU as the dependent variable.
 - Independent variables: included all other variables (based on GP and patient questionnaires):
 - Age
 - Sex (female/male).
- GP's questionnaire (based on his medical records):
- Number of chronic conditions based on a predefined list of 75 chronic conditions relevant to multimorbidity and coded according to the ICPC 2;
 - Number of drugs (0–4, 5–6, 7–9 or ≥10) listed by organic system (general, blood, immune, digestive, cardiovascular, respiratory, neurological,



endocrine, eye, ear, psychological, musculoskeletal) and by substance;

- Number of medical visits in the last year;
- Number of hospitalisations in the last year;
- The Severity Index (SI)^{36–38} was derived by dividing the total Cumulative Illness Rating Scale score, a validated questionnaire published elsewhere in detail,³⁹ by the number of categories with morbidities.

Patient interview (based on a questionnaire):

- Marital status (single, married, divorced or widowed);
- Educational level (primary, secondary and tertiary);
- DipCare questionnaire for deprivation assessment, containing 16 items examining the three dimensions of deprivation (material, social and health), and validated for the Swiss population and published elsewhere in detail;⁴⁰
- Treatment Burden Questionnaire, recently developed to produce a score for the overall burden related to the treatment of chronic conditions⁴¹; it consists of 13 questions to rate with an answer between 0 and 10, with 0 corresponding to no burden and 10 to a very important/considerable burden;
- Medical help from a home nurse;
- Paramedical therapist grouped together physiotherapist and/or occupational therapist (yes/no);
- Homecare (yes/no);
- Number of specialists involved in patient's care;
- EuroQuol 5 Dimension 3 Level (EQ5D3L) composed of five dimensions of health (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) and used a Visual Analogue Scale.

Statistical analyses

On collecting the questionnaires, the number of missing values from our variable of interest (HL score) was considered too high (ie, the HL score could not be computed in full for 577 participants) to reasonably analyse each participant's case in its entirety. We first considered computing the HL scores for all participants with at least five non-missing items. However, even then, the number of missing scores remained too high (377 participants), and comparisons between complete and the incomplete sets of responses showed significant differences in several covariates (data not shown). We therefore opted for the imputation of the missing values from the HL items and demographic covariates by using the multiple imputation approach developed by Rubin.⁴² As a sensitivity analysis, we carried out a complete case analysis, and this gave similar results.

We calculated means and SD for quantitative variables, and frequencies and proportions for categorical ones. Univariate and multivariate linear regressions were carried out to identify variables of HL. Using sensitivity analysis, we checked whether a model without imputations would produce the same results as the model with multiple imputations: analysis with and without imputation gave similar results.

All analyses were performed using R software V.3.3.2⁴³ and the MICE package V.2.29.⁴⁴

RESULTS

Descriptive analyses

Cases with at least one missing value among the six items were considered incomplete (239, 18, 417, 168, 252 and 175 missing values for questions (1) to (6), respectively). Of the original 888 patients, 200, 175, 117, 59, 24 and 2 had, respectively, 1, 2, 3, 4, 5 and 6 missing HL variables. Thus, a complete HL score was only computable for 311 respondents (35%), and we therefore chose to impute the missing values.

The mean age (SD) of the participants was 72.9 (12.0) years old; 52.0% were women. Almost half of the participants were married (49.0%), and 40.0% had a tertiary level of education. The mean (SD) number of chronic conditions was 7.20 (2.9), and the mean (SD) number of medical visits in the last year was 12.90 (8.7). The mean HL score (SD) of the participants was 2.9 (0.5). Descriptive statistics are summarised in [table 1](#).

In bivariate analyses with imputation, we found significant relationships between HL and almost all the covariates except for the number of chronic conditions, number of drugs, number of medical visits in the last year, number of hospitalisations in the last year, homecare, nurse and SI ([table 2](#)).

The multivariate analyses showed significant relationships between HL and the treatment burden score ($\beta=-0.004$, 95% CI -0.006 to 0.002); marital status, but particularly for the divorced group ($\beta=0.136$, 95% CI 0.012 to 0.260); dimensions of the EQ5D3L quality of life assessment, that is, moderate problems with mobility and moderate and severe problems with anxiety/depression ($\beta=-0.086$, 95% CI -0.157 to 0.016), ($\beta=-0.129$, 95% CI -0.198 to 0.060 and $\beta=-0.343$, 95% CI -0.500 to 0.186), respectively. [Table 3](#) shows the results of these multivariate analyses.

DISCUSSION

The present study showed that the mean (SD) HL score in our multimorbid primary care patient sample was 2.9 (0.5). In multimorbid patients, a high treatment burden and effects on patients' quality of life due to problems with mobility and anxiety/depression were negatively associated with HL. However, our study revealed no association between HL and age. Although several studies have assessed HL, to the best of our knowledge, little is known about which factors are associated with low HL in multimorbid patients in primary care.

The present study's main finding was that the treatment burden facing multimorbid primary care patients was negatively associated with HL. In other words, the lower a multimorbid patient's HL, the higher the treatment burden. This is a very interesting finding, and although the β coefficient is small, we believe that this result is

Table 1 Descriptive statistics of the sample of multimorbid patients, n=888

Variable	Mean*	SD*
Age	72.93	12.00
Health literacy score (577 missing values)	2.87	0.45
Material deprivation score	0.50	1.27
Social deprivation score	1.93	1.38
Health deprivation Score	0.48	0.68
No of medical visits last year (one missing value)	12.90	8.70
No of hospitalisations (three missing values)	0.54	0.99
No of chronic conditions (four missing values)	7.20	2.86
TBQ score	26.77	18.60
No of specialists (141 missing values)	2.23	1.27
Severity Index	1.75	0.38
Visual Analogue Scale (EQ5D3L)	63.19	19.25
Variable	Count	Prop
Sex		
Male	428	0.48
Female	460	0.52
Educational level (one missing value)		
Primary	195	0.22
Secondary	337	0.38
Tertiary	355	0.40
Marital status		
Single	85	0.10
Married	437	0.49
Divorced	150	0.17
Widowed	216	0.24
No of drugs		
0–4	156	0.18
5–6	212	0.24
7–9	276	0.31
≥10	244	0.27
Home nurse (one missing value)		
No	798	0.90
Yes	89	0.10
Paramedical† (12 missing values)		
No	572	0.65
Yes	304	0.35
Homecare (one missing value)		
No	755	0.85
Yes	132	0.15
EQ5D3L five dimensions		
Mobility		

Continued

Table 1 Continued

Variable	Mean*	SD*
No problems	497	0.56
Moderate problems	386	0.43
Severe problems	5	0.01
Self-care		
No problems	785	0.88
Moderate problems	92	0.10
Severe problems	11	0.01
Usual activities		
No problems	543	0.61
Moderate problems	328	0.37
Severe problems	17	0.02
Pain/discomfort		
No problems	211	0.24
Moderate problems	591	0.67
Severe problems	86	0.10
Anxiety/depression		
No problems	516	0.58
Moderate problems	329	0.37
Severe problems	43	0.05

*With multiple imputation.

†Paramedical includes physiotherapists/occupational therapists. EQ5D3L, EuroQuol 5 Dimension 3 Level; TBQ, Treatment Burden Questionnaire.

clinically relevant and allows us to identify treatment burden as an element to take into account for potentially low literacy in multimorbid patients.

There are no specific references to explain the association found between HL and the burden of treatment. As a proxy for treatment burden, some authors have described an association between low HL and treatment adherence^{45 46}; however, others found no evidence for such an association.^{47 48} Our exploratory study was unable to determine any causal association between the treatment burden and HL. But our results could also be considered from another angle, that has been taken in other analyses. Indeed, individuals with low HL are usually less well educated and belong to lower socioeconomic groups.¹⁸ Multimorbidity is higher in these groups and patients in them are likely to suffer more severely and from more diseases, leading to a higher treatment burden. Furthermore, low HL, used as an independent variable, has been found to be associated with a reduced ability of adults with coronary heart disease to identify medication,⁴⁹ poor health outcomes^{14 19 50} and a more significant use of healthcare.⁵¹ These three factors can also be linked to multimorbidity and may have an impact on the overall treatment burden.

Another important finding was that patients whose quality of life had been altered by problems related to anxiety/depression or mobility were more likely to have

**Table 2** Results of bivariate analyses with multiple imputation

Independent variable	β	95% CI	P value
Age	0.0053	0.0027 to 0.0079	0.0001
Sex	-0.1008	-0.1643 to 0.0372	0.0019
Deprivation			
Material deprivation	-0.0786	-0.1034 to 0.0537	0.0000
Social deprivation	-0.0485	-0.0707 to 0.0263	0.0000
Health deprivation	-0.1407	-0.1853 to 0.0961	0.0000
Educational level (reference: primary)			
Secondary	0.0408	-0.0464 to 0.1280	0.3579
Tertiary	0.0880	0.0034 to 0.1726	0.0415
No of medical visits last year	-0.0023	-0.0060 to 0.0014	0.2285
No of hospitalisations	-0.0283	-0.0598 to 0.0033	0.0789
No of chronic conditions	0.0042	-0.0076 to 0.0160	0.4820
No of drugs (reference: 0–4)			
5–6	-0.0249	-0.1238 to 0.0741	0.6217
7–9	0.0025	-0.0926 to 0.0976	0.9588
≥ 10	-0.0601	-0.1579 to 0.0377	0.2279
TBQ score	-0.0071	-0.0086 to 0.0055	0.0000
Home nurse	-0.1016	-0.2133 to 0.0100	0.0743
Paramedical*	-0.0843	-0.1489 to 0.0198	0.0105
Homecare	-0.0772	-0.1698 to 0.0153	0.1016
No of specialists	-0.0284	-0.0544 to 0.0024	0.0322
Severity Index	-0.0457	-0.1258 to 0.0344	0.2630
Visual Analogue Scale (EQ5D3L)	0.0048	0.0032 to 0.0064	0.0000
EQ5D3L five dimensions			
Mobility (reference: no problems)			
Moderate problems	-0.1507	-0.2131 to 0.0882	0.0000
Severe problems	-0.1404	-0.5589 to 0.2781	0.5100
Self-care (reference: no problems)			
Moderate problems	-0.1965	-0.3045 to 0.0884	0.0004
Severe problems	-0.1464	-0.4724 to 0.1795	0.3755
Usual activities (reference: no problems)			
Moderate problems	-0.1729	-0.2371 to 0.1086	0.0000
Severe problems	-0.4167	-0.6521 to 0.1813	0.0006
Pain/discomfort (reference: no problems)			
Moderate problems	-0.1174	-0.1970 to 0.0378	0.0040
Severe problems	-0.2760	-0.3961 to 0.1558	0.0000
Anxiety/depression (reference: no problems)			
Moderate problems	-0.2211	-0.2839 to 0.1584	0.0000
Severe problems	-0.5390	-0.6788 to 0.3991	0.0000
Marital status (reference: single)			
Married	0.1596	0.0484 to 0.2709	0.0050
Divorced	0.0947	-0.0315 to 0.2208	0.1412
Widowed	0.1128	-0.0057 to 0.2313	0.0619

*Paramedical includes physiotherapists/occupational therapists.

EQ5D3L, EuroQuol 5 Dimension 3 Level; TBQ, Treatment Burden Questionnaire.

Table 3 Results of multivariate analyses with multiple imputation

Independent variables	β	95% CI	P value
Age	0.0007	-0.0027 to 0.0041	0.6889
Sex	-0.0361	-0.1043 to 0.0320	0.2981
Deprivation			
Material deprivation	-0.0245	-0.0533 to 0.0043	0.0954
Social deprivation	-0.0235	-0.0480 to 0.0010	0.0606
Health deprivation	0.0221	-0.0364 to 0.0806	0.4577
Educational level (reference: primary)			
Secondary	0.0070	-0.0763 to 0.0903	0.8688
Tertiary	0.0560	-0.0284 to 0.1405	0.1929
No of medical visits last year	0.0009	-0.0029 to 0.0048	0.6302
No of hospitalisations	-0.0183	-0.0503 to 0.0136	0.2603
No of chronic conditions	0.0096	-0.0032 to 0.0224	0.1399
No of drugs (reference: 0–4)			
5–6	-0.0278	-0.1210 to 0.0653	0.5577
7–9	0.0276	-0.0647 to 0.1199	0.5568
≥ 10	0.0110	-0.0905 to 0.1125	0.8318
TBQ score	-0.0038	-0.0058 to 0.0018	0.0002
Nurse	0.0228	-0.1120 to 0.1577	0.7390
Paramedical*	-0.0327	-0.0968 to 0.0314	0.3172
Homecare	0.0057	-0.1069 to 0.1183	0.9205
No of specialists	-0.0235	-0.0513 to 0.0043	0.0967
Severity Index	0.0385	-0.0420 to 0.1190	0.3480
Visual Analogue Scale (EQ5D3L)	0.0000	-0.0019 to 0.0019	0.9722
EQ5D3L five dimensions			
Mobility (reference: no problems)			
Moderate problems	-0.0864	-0.1567 to 0.0161	0.0161
Severe problems	0.1663	-0.3459 to 0.6786	0.5230
Self-care (reference: no problems)			
Moderate problems	-0.0440	-0.1552 to 0.0673	0.4379
Severe problems	-0.0661	-0.4830 to 0.3508	0.7532
Usual activities (reference: no problems)			
Moderate problems	-0.0244	-0.0998 to 0.0509	0.5242
Severe problems	-0.1912	-0.4453 to 0.0630	0.1402
Pain/discomfort (reference: no problems)			
Moderate problems	-0.0033	-0.0847 to 0.0780	0.9356
Severe problems	0.0073	-0.1297 to 0.1444	0.9161
Anxiety/depression (reference: no problems)			
Moderate problems	-0.1288	-0.1978 to 0.0598	0.0003
Severe problems	-0.3426	-0.4996 to 0.1857	0.0000
Marital status (reference: single)			
Married	0.0953	-0.0146 to 0.2053	0.0890
Divorced	0.1360	0.0122 to 0.2599	0.0314
Widowed	0.0780	-0.0477 to 0.2037	0.2233

*Paramedical includes physiotherapists/occupational therapists.

EQ5D3L, EuroQuol 5 Dimension 3 Level; TBQ, Treatment Burden Questionnaire.

low levels of HL. As described by DiMatteo *et al*, anxiety and depression may affect patients' motivation and ability⁵² to seek out and understand information about their diseases and treatment, resulting in a lower level of HL, especially in the complex context of multimorbidity. Moreover, anxiety and depression may well be higher when patients have to face up to more numerous health problems, especially in multimorbidity. This result is not concordant with the study by Green *et al*,⁵³ which found no association between limited HL and depression in patients receiving chronic haemodialysis treatment, but this difference might be explained by the differences in the study populations, how HL was assessed and the fact that his study used HL as independent variable.

Concerning the association between mobility problems and low HL, Matsumoto and Nakayama describe a relationship with different social determinants of health such as housing, employment, transport or social support.⁵⁴ On the other hand, in a very different population, there was a strong association between low HL and obesity in young children with a described lack of physical activity.⁵⁵ However, we can only speculate as to whether there is any precise explanation of the associations between anxiety, depression, mobility and HL. Furthermore, due to its design, the study's findings cannot determine a causal association.

Anxiety, depression and mobility are just some of the determinants of quality of life, and the literature reveals very controversial results concerning the association between HL and quality of life. It seems that such associations may depend on certain other aspects, such as specific chronic diseases or the cultural characteristics of the population studied.⁵⁶ Thus, although we found that some of the determinants of quality of life are factors associated with low HL, we believe that further studies are necessary to better understand the underlying reasons for the controversial results in the literature. However, it nevertheless seems important to describe factors associated with low HL, thus allowing GPs to better identify such patients and to adapt how they inform them about medical problems.

The present study found no association between the level of HL of multimorbid primary care patients and their use of healthcare services, especially with regards to the number of consultations with their GP or the number of hospitalisations in the past year. Results in the literature are inconsistent. The study by Vandenbosch *et al*⁵¹ found no significant associations between HL and the number of medical visits or hospitalisations, whereas a study by Duong *et al*⁵⁷ described an association between HL and healthcare use. These results are inconsistent due to differences in the study populations (ie, our study population was composed of multimorbid patients in primary care settings) and methodologies (other studies considered HL as an independent variable). Indeed, we suggest that HL in multimorbid patients is different from that in the general population and should be assessed

differently. Further research should aim to clearly confirm or invalidate our results with multimorbid patients.

Strengths and limitations

This national primary care study enabled the analysis of data from a relatively representative sample of multimorbid patients suffering from at least three chronic conditions and enrolled in GPs' practices across Switzerland. Although several studies have previously assessed HL, to the best of our knowledge, this was the first to have assessed factors associated with HL in multimorbid patients in a primary care setting.

However, this study had some limitations. First, the β coefficients were small, making clinical interpretation difficult, despite the fact that the study gives an overall view of the factors associated with HL. Further studies should be done to confirm these trends.

Second, our sample might not be perfectly representative of all multimorbid patients. GPs only recruited patients who came to their practices and who were suffering from at least 3 chronic conditions from a list of 75 provided to them. The most impaired multimorbid patients, therefore, those with the most extensive mobility problems (ie, those cared for via homecare visits, in nursing homes or hospitalised) were not included (selection bias). Our results concerning HL in multimorbid patients should thus be interpreted with caution, taking into consideration multimorbid patients who cannot attend GPs' practices or who have rare chronic conditions. Furthermore, we cannot exclude a potential selection bias, as patients who consulted more frequently had a higher chance of being included. However, we found no association between the frequency of consultations and HL in our final model.

Third, the HL score contained a lot of missing values, and we cannot exclude that the cause of that missing data was related to HL itself. However, we examined whether the mean of the available HL items was associated with the number of missing HL items, and this was not the case.

Fourth, due to the study's cross-sectional design, causal relationships cannot be inferred.

CONCLUSION

The present study highlights factors associated with HL in multimorbid patients in primary care: a high treatment burden, altered quality of life by problems with anxiety or depression and poor mobility were associated with a low level of HL. This is a useful information that could guide GPs in their daily practice and help them to better identify patients at risk of having low HL. Even though, with the current state of knowledge, we cannot demonstrate causal relationships between multimorbidity and the treatment burden, GPs should carefully weigh up how best to transmit clinical information to patients whom they believe to be at risk of low HL.

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Contributors AAN, AD-L, BB, DMH, AZ, LH and PB developed the protocol for the MMFM study. LH, AZ and DMH ensured the recruitment of participating GPs. AAN was primarily responsible for planning the analysis and drafting the manuscript. JP was responsible for the analyses. PB, JP, and LH helped to improve the manuscript during this process. BB, AD, DMH, SS, SNJ, AZ, PB and LH made contributions to the interpretation of the findings and the content of the final manuscript. All authors read and approved the final manuscript.

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Data sharing statement Data are available at family medicine institute of Lausanne.

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